CHAPTER 14
Sunset

I came back to my country that was in a most confused state. As a nation we were hopelessly hemorrhaging in Vietnam and fighting ourselves at home with racism as a demon on the rampage.

I couldn't wait to fly home to Milwaukee and drive down to Racine where Nancy was a science teacher at Starbuck Junior High School, and oddly after initial hugs and kisses, we faced each other as very different people. That is the toll polar field work extracts. The intense painful work of trying to obtain impossible data from a severe climate and a dangerous geographical location in isolation was not understood at all except by the polar rats who call this kind of work their own. Each time I went South it turned me inward to myself so much that it was very hard to open up even to loved ones I should have trusted. Again I found people like Bill Weyant or Paul Dalrymple or other military personnel as the only people who understood me.

Bob Geissel, who had spent two years somewhat isolated in the Peace Corps and then a year at Plateau Station, blew up and resigned the Coast and Geodetic Survey when he saw not much was happening with the data he collected. He spent his year's salary on an ocean going sailboat, lived with a girl named Marie on his boat and docked at Buzzard Point Boat Yard on the Anacostia River of the District of Columbia. When finances grew tight, they ate a steady diet of potatoes and onions. The last I saw of Bob and Marie was a night we spent waxing eggs for their ocean trip to the Caribbean. Losing such good friends was another painful hurt of polar work.

31 March 1968. "Tonight I have ordered our aircraft and our naval vessels to make no attacks on North Vietnam, except in the area north of the demilitarized zone where the continuing enemy build-up directly threatens allied forward positions and where the movements of their troops and supplies are clearly related to that threat. The area in which we are stopping our attacks includes almost 90 percent of North Vietnam's population, and most of its territory. Thus there will be no attacks around the principal populated areas, or in the food-producing areas of North Vietnam. . . . I shall not seek, and I will not accept the nomination of my party . . . " (An address by President Johnson to the nation.)

Becoming reacquainted with Nancy was not easy. I was committed to my polar studies and she was committed to teaching. Northwest Orient Airlines improved their stock rating between my return from the *Fuji* and our wedding. Nancy most frequently took a plane to Washington, D. C. soon after school was out in Racine on Fridays and returned as late as possible on Sunday nights. An airline stewardess asked her if she commuted to Wisconsin every week.

Historically, to be planning a wedding and starting a family in 1968 was the very wrong thing to do logically. The times were so uncertain. The unending war in Vietnam would not go away. As a nation we neither had the courage to fight all out putting our own nation at risk nor the courage to sue for peace. I believe we simply were wrong trying to maintain dictatorial powers in the South while dictatorial powers of the North likewise wanted control. This was not a war of vital interests to the United States. Protests in the streets grew more frequent, larger, and more violent. A mild mannered speaker, Senator McCarthy of Minnesota, won a Democratic primary against President Johnson which brought Senator Robert Kennedy into the race against the President in his own party.

Marches for civil rights also grew in number and violence as the movement began to hit the real issues of bigotry, poverty, capitalism without a soul. On 4 April 1968, while preparing a demonstration for the impoverished garbage collectors, Martin Luther King, Jr. was assassinated in Memphis. American city after city burst into flames with riots and protests. From the Polar Met office in the Grammax building in Silver Spring, Maryland we watched sections of D. C. burn.

With compassion for a black man who worked for Polar Met as a technician, I tried at great risk to drive him downtown between burning blocks and dodged military police jeeps at times at high speed down alleys. The bus station was closed and we had to sneak back out of the city now under martial law. I never was so scared. Once we escaped and were past the beltway, I gave up any personal plans and drove Sam to his home in Harrisburg, Pennsylvania.

It was a measure of my own bigotry. I was a professional meteorologist with a very high salary, and this man was working for us at this government office, an equal opportunity employer. Yet, I did not know Sam's last name, nor did I know that his wife and children lived so far away because Sam could not afford housing in the D. C. area suitable for his family. Taking him home I learned both about him and myself.

As long as I was in Pennsylvania I continued driving to my friend, Don Holz' place in Philadelphia, but it too was a city about to explode. The mayor of Philadelphia did a marvelous thing. Instead of ordering his police department to "shoot to kill" as the Chicago major did, the Mayor of the City of Brotherly Love lived up to that name by ordering all public buildings open and encouraged everyone to come downtown to mourn the loss of a great American. The remainder of the night Don Holz and I sang the protest songs of Black Americans arm in arm with them in prayers for hope.

Thirty years later, when my church body throughout its lily white schools refuses to recognize Martin Luther King Day, I am reminded of my own bigotry again and realize in my part of the Christian Church, we are all still very racist. Maybe only in Heaven it will be right, and that cliché is not good enough.

Near Easter Nancy visited me again at Laurel Lodge and we attended the Union of Geophysical Research Convention in the District of Columbia now marred by being under siege. Military armored carriers were everywhere. Soldiers were on every corner with either automatic weapons or rifles with fixed bayonets. At one scientific presentation, a paper on the history of the atmosphere on Mars, one scientist angrily asked why we were so wealthy and concerned with air on Mars when the air in our city was polluted and poor people were dying of lung cancer and lead poisoning. In a rare demonstration of emotion many cheered and the Martian session was over.

After these meetings, and with armed military escort, Nancy and I purchased our wedding rings at a store near Eleventh and "G" Streets Northwest. Some time in May I received another telephone call from the State Department. I was invited to join the Russians at Vostok as guest scientist. There was a potential of a fellowship at the Soviet Polar Institute in Leningrad for as long as three years after my tour at Vostok. I might be able to take Nancy with me to the Soviet Union. Plateau Station was scheduled to be closed before I would be at Vostok so that a major objective for doing meteorological experiments and collecting low level weather data would be impossible. Marriage was looking a lot warmer.

In corresponding with Rob Flint, he wrote to me about satellite communication between scientists in the field and scientists with their computers at home with the power of near instant analysis. As it turned out, he did go to Vostok and maintained a career with Polar work, always managing a

strong independent life to keep strong relations with his wife and children over the many polar years. Chuck Sterns of the University of Wisconsin also was involved with Flint in years to come as they developed robot observers that were placed in the most isolated and severe places of the Antarctic to communicate with satellites and computers. I have always been thankful to know that many of my ideas and ideas of others with which I had input were correct. Today the French still are exploring the interrelationship between katabatic and inversion winds.

More and more riots occurred. It was amazing that this democracy still intended to carry out its election. Then, on 6 June, Bobby Kennedy was killed. There simply were too many "lone gunmen." I never believed that. There were conspiracies by men in high places without a doubt. What was happening to my country?

On 15 June 1968 Nancy and I were married and our first born son, Paul Martin, was soon conceived. Paul was born on 18 March 1969. Bob Geissel no longer had to worry if we were radiated and sterilized by all of the radiation of the Southern Lights.

The project performed on the *Fuji* had many loose ends left undone and now I was working on them in a backward fashion because of the haste with which I had to meet the Japanese before the trip. I was becoming quite good at manipulating the myriad of government offices that impinged on my research. The hula hoops I had to jump through or get others to jump through to move helium to Australia and put on a former enemy military ship was small potatoes when compared with the bureaucratic needs and paper forms required before I could fly kytoons at the Weather Bureau's Experimental and Testing Station at Sterling Virginia, only a mile from Dulles International Airport.

Nothing was as "governmentally bureaucratic" as my effort to finally calibrate the wind sensors used on the *Fuji*, or at least those sensors that I still had not lost at sea. While at my old classmate Don Panzenhagen's home, I met a military officer from Andrew's Air Force Base who was in charge of a research team that used a wind tunnel. Ideal. This wind tunnel was just ten miles around the beltway. He had a staff eager to assist. We even had a lot of mutual science worthy of exchange. He would arrange for security clearance. My security checks were still up-to-date and valid. No problem.

The time came to move my equipment from my office in Silver Spring, Maryland to Andrew's. As I was loading my car's trunk while parked in a no parking zone in front of the Grammax Building, Bill Weyant came and asked what I was up to. I told him. I apologized for not telling him too far ahead, but it was all arranged. Well, he needed to make a few calls just to make sure.

By noon I was still parked in that no parking zone. It was getting harder to fake loading after four hours. Bill had checked with his boss, Lester Machta, Deputy of the Air Resources Laboratory. Lester Machta had to check with his boss, Allen Shapley, Office of Programs, who in turned checked with Bob Culnan, ESSA Liaison Officer, and maybe Weyant's question climbed to George Benton, Director of the Research laboratories and on to the Military Advisor to the Administrator of ESSA. I have no idea how far into the Department of Commerce and perhaps over to the Department of Defense, but no one would say "yes, I, a scientist in the Department of Commerce, could use a wind tunnel in the Department of Defense. At the end of the day Weyant told me that I perhaps should cancel my plans at Andrew's Air Force Base until we received a more definitive answer. As I drove home to Harper's Ferry, I littered Interstate 70 with many small pieces of a parking ticket from the Silver Spring Police Department.

The final brilliant administrative ruling came about a week later. I could not use a wind tunnel across departmental lines. I could not use a Department of Defense wind tunnel unless a Department of Commerce wind tunnel was not available. I spent another month locating Department of Commerce

wind tunnels. One was in Norman, Oklahoma at the National Severe Storms Lab, and a second one was found at the National Nuclear Reactor Test Site in Idaho Falls, Idaho. On the government flow chart Idaho Falls was the closest wind tunnel. I had to air freight nearly a thousand pounds of equipment and spend a week in hotels at high per diem. Herb Viebrock came along.

A life time thrill for me was representing ESSA at SCAR's (Scientific Committee on Antarctic Research) International Symposium on Antarctic Glaciological Exploration. Nearly the entire global community of glaciological scientists was represented at this ISAGE conference held on the Dartmouth College campus and near the Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, New Hampshire. Amazingly I knew most of these scientists either by having met them previously or by reading their works or both. Likewise most of them knew me.

There were scientists from Australia, Austria, Belgium, Canada, Denmark, England, France, Japan, New Zealand, Norway, South Africa, Sweden, Switzerland, USA, and USSR. I was on a high mountain and was looking at all the kingdoms of the world and their splendor as I knew it for polar research.

Those to tease at the conference were three pair of honeymooners, Burt Crary and his new wife, Olav and Billy Orheim, and Marty and Nancy Sponholz. Much attention was paid to Mrs. Crary and her little secrets about the Chief Scientist of the National Science Foundation. With all the wealth and prestige of Burt's position, his clean, white well-pressed shirts were only white and well pressed from his tie to his lapels. The rest were worn to less than a few threads.

The glamor of science became quite heady. There was wine, great banquets, and praise from all over the world for the promises my research efforts were providing the glaciological community. It was also a time to be attracted to new positions of employment and higher wages. Collin Bull of the Polar Institute with Ohio State University discovered Nancy had a degree in biology and offered us a tempting position for research as a married research team to glaciers in the Palmer Peninsula. We both declined his offer without giving the reason (Nancy was pregnant with Paul), which only made Collin pursue us all the more.

It was quite evident that Werner Schwerdtfeger's theory of inversion winds was making a major impact. I more than enjoyed being part of these discoveries in the making. Whereas most glaciologists suggested ice ages were brought on by a planetary long term cold climatic change, a wind system that held the cold and moisture within the icecap shielded it from the planetary climatic changes or at least insulated it from planetary warming periods except for perhaps exceptionally long and hot periods.

This, of course, also meant the ice ages more than likely and Antarctica very definitely had a life much longer than ever imagined. This was hard for me personally to swallow. I was taught in Christian day schools all of my precollege life. I was also taught science and the Bible both lead to the truth and that, of course, they never could contradict each other. That science just might stray from certain truth was the least of my concerns. I knew many of the modern taverns where new scientific ideas were derived.

I was stunned at the almost total lack of interest in religion of any kind by so many of these scientists who now were my friends by virtue of the camaraderie established through frost bite, risk, and survival. Most of them also wore penguin tie clips. Their lack of interest in religion of any kind reminded me of Robert Falcon Scott's first failing attempt to reach the South Pole, 1901-04 Great Britain National Antarctic Expedition. Scott, Shackleton, and Wilson reached 82 º 17' S and severe weather and lack of supplies forced them to return.

"It was a Sunday and Wilson, propped up in his sleeping bag, held a kind of church service, reading the psalms, epistle and gospel for that day. One of the psalms happened to be number forty-six, *God is our Hope and Strength*. "Therefore will we not fear, though the earth be moved," it ran, appropriately, "and though the mountains shake at the tempest." Afterwards Scott insisted on a chapter of Darwin, which was his way of scoring off Wilson. Wilson was religious, Scott the reverse. Scott had brought the *Origin of Species*, in Shackleton's words, "to while away such days as these." It was the bible of the agnostic. To please Scott, or in deference to his rank, it was read aloud by Shackleton and Wilson in turn."

"This was Shackleton's introduction to Darwin, reading aloud in a tent on the edge of the unknown. "As natural selection works solely by and for the good of each being," Shackleton read out, "all corporeal and mental endowments will tend to progress towards perfection." That was reassuring doctrine to hear while the snow hissed on the canvas of the tent, and nature with her little finger stopped the march." (Roland Huntford.*Shackleton*. New York: Fawcett Columbine, 1985, page 92.)

One reoccurring problem kept emerging from discussions of paper after paper. The top layers of the icecap clearly show seasonal layers with differing density for summer and winter. Even pollen grains blown in from great distances clearly mark seasons of pollination that were occurring in more northerly continents. Snow gave way to compressed ice at deeper layers and different densities of snow change into seasonal differences with air bubbles trapped in the ice. At approximately three thousand feet down all bubbles disappear. There still exists more than nine thousand feet of ice below this level in Antarctica. The level of disappearing bubbles occurs at the same level in Greenland. The very ice core from Greenland was preserved at CRREL for all of us to examine. What caused this mysterious disappearance?

I asked, "Could the layer underneath be frozen flood waters from the time of Noah? Mad hysteria ensued! It was the joke of the convention. For days after, at every evening cocktail hour I had scientists from all over the world slapping me on the back for breaking up the intense theoretical debates. The laughter was redirected when I privately confessed to several that I believed that there was a Noachic Flood. When a dust layer revealed itself deep within the Byrd ice core and under the regions of the bubbles, as rumor of my beliefs spread throughout the convention many scientists went out of their way to point out these ashes were probably from Noah burning trash and Sponholz would know.

These volcanic ashes embedded deep within the ice sheet are to me as much a puzzle as the lack of bubbles. But why this personal ridicule? Many years later the most acceptable scientific explanation for the lack of bubbles seems to be that at the extreme cold temperatures and high pressures so deep under the snow, a gas is dissolved by the solid ice molecule by molecule and remains undetected until the ice is melted and analyzed chemically. I certainly don't have an exact and certain scientific proof of the Flood, but I don't have a scientific explanation for the true resurrection of Jesus at Easter either. I believe He rose from the dead as He will call me to rise on the Last Day.

The mountain top view of the pinnacles of scientific understanding of the world all around me were majestic. I learned to worship my Lord, the God of all, and serve Him only. I returned with Nancy to our home in Harper's Ferry confused with much of the glamor of science taken away.

Duties remaining in Washington, D. C. covered a wide range such as training men for Antarctica as a pay back to Charlie Roberts and the many others of OPPS who were so helpful on my two

expeditions. When Ray Herr became swamped with grant approvals at NSF, I occasionally was asked to provide judgments on proposals. Some Russian translation work always plagued me. Once I needed to scramble for ice thickness and strength data to be radioed to a pilot in trouble past the point of no return headed toward Antarctica. There were many government hearings of every kind and nature.

Shortly after Plateau Station was closed after it's third year of operation, its last scientific leader, George S. Rubin de la Borbolla, demanded a NSF hearing accusing the U. S. Navy of sabotaging scientific work. In addition, Tom Frostman, the third year meteorologist nearly suffocated of carbon monoxide poisoning and it took some time for the medical doctor to revive him. Not much scientific data came out of Plateau that year.

The Navy versus civilian scientists has been a problem since the start of our republic. The very first U. S. Exploring Expedition, 1838-1842, led by Lieutenant Charles Wilkes started with his strong dislike for civilians.

> "All the duties appertaining to Astronomy, Surveying, Hydrography, Geognosy, Geodesy, Magnetism, Meteorology, and Physics generally to be exclusively confined to Navy Officers. No others were so well qualified to perform them. And the lesser departments of science - zoology, geology, mineralogy, botany, conchology - to be filled up as far as can be done from among the medical corps attached to the expedition. Only if medical officers of sufficient learning could not be found were civilians to be appointed, and they were to be placed entirely under control and direction of the Commander of the Expedition." (Much of this quotation is attributed to Charles Wilkes, in *The Great United States Exploring Expedition*, by William Stanton, University of California Press, 1975, p. 63)

After nearly a half day of hearings with George doing most of the testifying, me giving similar anti-Navy feelings and Dalrymple testifying of his many years of both bad and good relations with the military, the number two bureaucrat, Phil Smith, waltzed in, spoke nothing but bureaucratese for thirty minutes and concluded nothing could be done. Logistics in Antarctica simply were not possible without the commitment of a major military operation. I couldn't stand him, but he probably was right. I'm still very glad Rob Flint invented a two-by-four Navy replacement that made our year at Plateau Station a very successful one.

Pure research projects, of their very nature, are only temporary. Once discoveries are made and knowledge passed on through publications the research scientists move on as well. We knew that the sunset of polar met was imminent when Lester Machta, Director of Air Resources Lab, Don Pack, the Deputy Director of ARL, and Mort Rubin, then with ESSA Headquarters visited our entire staff to assure everyone a smooth transition to new professional positions.

Bill Weyant was the first to depart taking a position with a professional bridge circuit. Actually, many of the professional scientists were already doing research on non-polar projects. Herb Viebrock and Bernie Lettau's research turned to global problems. Likewise, Bob Becker's work became most concerned with the stratosphere, but he joined his wife's food catering service during the day and established a pizza place for nights and weekends.

After I returned from my voyage with the *Fuji*, I could provide Martin Predoehl with many photographs of the sea and could also connect them quite accurately with latitude and longitude. He became more and more interested with early verification of satellite observations. This whole field was about to explode and change the entire view of meteorology.

The inversion study was still unfinished but had been given a setback not having any data from Frosty's year. And Herb's and my convergence zone project with the kytoons was the only new polar program. It was a good time for sunset for post IGY projects.

The government was most generous to make sure adequate time and place could be provided that research projects were seen to completion. Herb, loyal to Polar Met to the end, took what was left of the oceanographic studies from the *Fuji* for final publication and continued meteorological research associated with the National Institute of Health.

Pack and Machta gave me great encouragement; they told me I had the highest reputation in the government for getting data out of impossible places. They would have provided a place in their Atmospheric Trajectory Branch if I needed an office to complete my inversion study. I was more than surprised that Dr. Johannessen, Associate Director, Meteorological Operations (2nd in command of the Weather Bureau) paid me a very personal visit. He had traveled with me to New Zealand while I was en route to the *Fuji*, and I debriefed with him about some of my experiences with the meteorological agencies in Australia that I visited.

With Dr. Johannessen's encouragement for me to pursue a PhD in meteorology the dye was cast. I would be going back to school on a fellowship. I would be leaving the Weather Bureau but not resigning. Dr. Johannessen even suggested that there might be a reconstituted polar studies' agency in the government if I still loved the Poles when I returned. Talent was hard to come by. Talent for hardship places was more than rare and the world was ready to pay a good price for those talents.

Nancy, first born son Paul, and I returned to the University of Wisconsin in the summer of 1969 after my four years with Polar Met in Washington, D. C. Plateau data was now on the Madison campus where it got its start. My research continued without delay just as it did in D. C., only now with the direct guidance of Professor Lettau and Professor Schwerdtfeger.

I shared an office with Bob Gall and Larry Mahrt. At first I was apprehensive being on the same research team with a man I was a little jealous of for his priority with the mathematical model of my research. My mathematical skills I felt were as good as anybody's, but while I was in isolation Larry wrote the model for what I wanted to do. I also believed observations should precede theory, but I was absolutely wrong on that score. In fact, theory even precedes application for grants. Judgments for grants are based on the promise of theory and never on cold uninterpreted data.

My envy of Larry was unfounded. He and Bob Gall became great friends of mine as we struggled together with Schwerdtfeger over research issues dealing with polar meteorology. My unfounded feud with Larry reminded me of a similar feud between Robert Falcon Scott and Ernest Shackleton over ownership to a base on Ross Island and over the Beardmore Glacier. No one owned Antarctica. No one owns meteorology or any other part of nature. Research is open and competitive. In the Scott versus Shackleton feud when Shackleton used an old base of Scott's over Scott's objection, Shackleton discovered the great Beardmore Glacier that was the open highway to the South Pole. Scott hiked up the Beardmore Glacier to be the very second expedition to the South Pole only thirty-two days after Roald Amundsen's victorious achievement 15 December 1911. Yet in my view Shackleton should be recognized as the first to the South Pole. By climbing the Beardmore Glacier and marching to a position which was only ninety-seven miles of flat terrain between him and the South Pole, he was really the first to the South Pole and beat both Amundsen and Scott by two years to the high polar plateau.

"December 28. If the Barrier is a changing sea, the plateau is a changing sky. During the morning march we continue to go up hill steadily, but the surface was

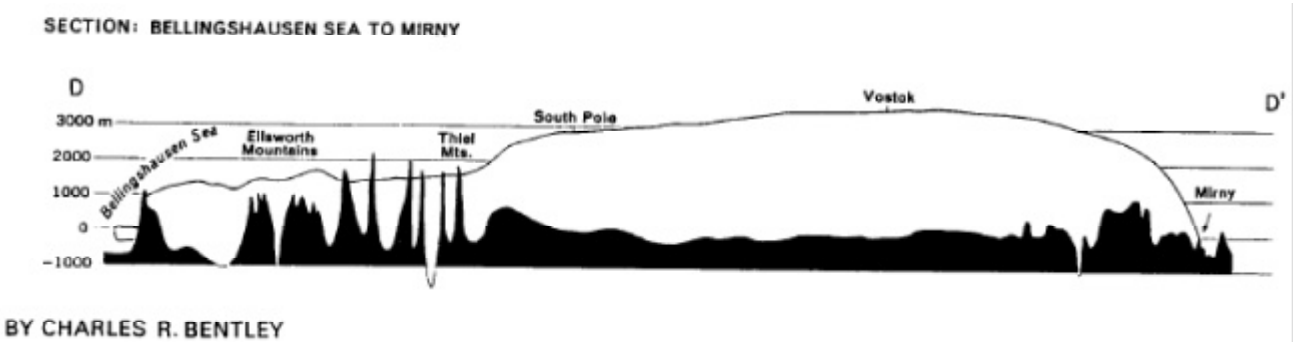
constantly changing. We are now 10,199 feet above sea level, and the plateau is gradually flattening out, but it was heavy work pulling this afternoon. The high altitude, and a temperature of 48 º of frost made breathing and work difficult. We are getting south - latitude 86 º 31' South tonight. The last sixty miles we hope to rush, leaving everything possible, taking one tent only and using poles of the other as marks every ten miles, for we will leave all our food sixty miles off the Pole except to carry us there and back. I think the country is flattening out more and more, and hope tomorrow to make fifteen miles, at least."

January 9 [1909]. Our last outwards. We have shot our bolt, and the tale is latitude 88 º 23' South, longitude 162 º East. The wind eased down at 1 a.m., and at 2 a.m. were up and had breakfast. At 4 a.m. started south, with the Queen's Union Jack, a brass cylinder containing stamps and documents to place at the farthest south point, camera, glasses and compass. At 9 a.m. we were in 88 º 23' South, half running and half walking over a surface much hardened by the recent blizzard. It was strange for us to go along without the nightmare of a sledge dragging behind us. We hoisted her majesty's flag and the other Union Jack afterwards, and took possession of the plateau in the name of her Majesty. While the Union Jack blew out stiffly in the icy gale that cut us to the bone, we looked south with our powerful glasses, but could see nothing but dead white snow plain. There was no break in the plateau as it extended towards the Pole, and we feel sure that the goal we have failed to reach lies on this plain. We stayed only a few minutes, and then, taking the Queen's flag and eating our scanty meal as we went, we hurried back and reached our camp about 3 p.m. We were so dead tired that we only did two hour's march in the afternoon and camped at 5.30 p.m. The temperature was minus 19 º Fahr. Fortunately for us, our tracks were not obliterated by the blizzard; indeed, they stood up, making a trail easily followed. Homeward bound at last. Whatever regrets may be, we have done our best." (Ernest Shackleton, *The Heart of the Antarctic*, London, 1909)

There simply is nothing new to discover between 88 º 23' South and 90 º 00' South. Shackleton discovered it all and first. Larry Mahrt's formulas may have been first, but I was first meteorologist to gather the data during the winter at Plateau Station. These research tracks were my tracks. And if priority was all important, both Larry and I were students of Schwerdtfeger and Schwerdtfeger's ideas were spawned in a lifetime of Southern Hemisphere research.

University research was different from government research. I had more material, more contacts, more exchange of ideas, and less pressure to work on the inversion winds while I was a research meteorologist for the government. I had more encouragement and more supervision at the university. Without a doubt, a PhD candidate discovered his professor's ideas.

[The next several pages were not posted on The New South Polar Times internet site. I am sure the graphs and math were a tad beyond K-12. Nancy and I had two sons both of whom earned engineering degrees from the University of Minnesota-Twin Cities. At the family supper table one Thanksgiving Day the conversation strayed into the distant past when the engineers suggested their math was beyond old dad. Indeed at my little college, where I teach future pastors and teachers, differential equations are not parts of sermons nor eighth grade science. But the saddest part of life is that your children never see you in your youthful power days. By and large that is probably for the



best and of course dad is only dad. But physics is physics. So for Paul and Mark the fluid flow of the atmosphere as I knew it and tried to explain it follows. The more time passes the more science changes and I am sure the science literature since 1970 demonstrates that for inversions winds also.]

A LIST OF SYMBOLS USED
(in order used)

z	=	ordinary vertical coordinate of height above the snow surface.
T_h	=	temperature at the top of the inversion.
ΔT	=	temperature difference between the top of the inversion and the surface.
z^*	=	independent variable in the vertical in nondimensional form.
k	=	coefficient of eddy diffusivity.
f	=	Coriolis parameter.
$\vec{C}_T$	=	thermal wind.
$\vec{C}_T(z)$	=	finite difference thermal wind between level "z" and the top of the inversion layer.
g	=	acceleration due to gravity.
T_s	=	temperature at the base of the inversion.
$\vec{G}$	=	slope of the snow surface or icecap.
$\vec{k}$	=	non-dimensional unit vertical vector.
$\vec{P}_T$	=	a component of the horizontal pressure gradient force due to the thermal wind.
A	=	a constant of proportionality to be determined from boundary conditions.
P_x	=	"x" component of the pressure gradient force.
v_h	=	"y" component of the horizontal wind vector at the top of the inversion.
P_y	=	"y" component of the pressure gradient force.

u_h = "x" component of the horizontal wind vector at the top of the inversion.

v_{gs} = component of the surface geostrophic wind in the "y" direction.

z_s^* = non-dimensional height of the surface wind level.

F_x = "x" component of the variable force of friction.

F_y = "y" component of the variable force of friction.

The genius of the Schwerdtfeger-Mahrt mathematical model for the inversion winds was their tie of the shape of the surface of the ice dome to the wind profile above. They did this by first modeling the temperature profile relative to height above the snow surface according to the expected radiational cooling. They formulated this profile as an exponential function (e ≈ 2.71828182846) with the power of the "e" function being the height.

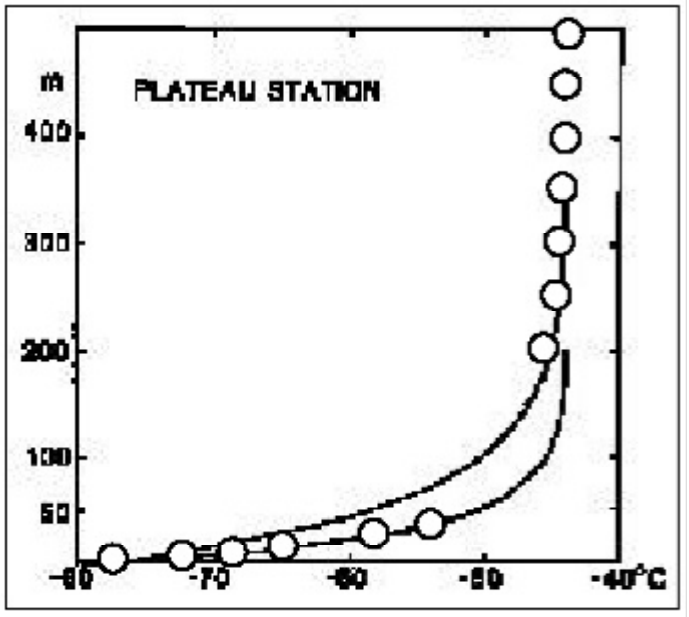
$$T(z) = T_h - \Delta T e^{-z^*}$$

where

$$z^* = \frac{z}{\sqrt{k/f}}$$

for the purpose to make heights non-dimensional.

Two attempts were made to match with the real temperature profile of the inversion, but nature does not use one formula for part of itself and the same equation with a different set of constants that happen to fit for another part. Their exponential function was correct. However, Prof. Schwerdtfeger's own studies led to views that super saturated sinking air in the lower regions of the great inversion ice crystals were condensing out of a clear sky, and this would add heat to this layer as I explained and graphically showed in chapter nine.



In chapter four I explained Schwerdtfeger's idea that the great inversion similarly formed on the sloping ice dome created a horizontal temperature gradient that produced a thermal wind.

A thermal wind equation first published by Dalrymple for South Pole data follows.

$$\vec{C}_T = \left(\frac{g}{f}\right)\frac{\left(T_h - T_s\right)}{\bar{T}}\vec{G}\times\vec{k}$$

By substituting the variable function of temperature with respect to height in the thermal wind equation in the place of the surface temperature Schwerdtfeger and Mahrt obtained an elaborate pressure gradient equation.

$$\vec{P_T}(z) = \vec{k} \times f\ \vec{C_T}(z) = -\frac{g\Delta T}{\overline{T}} e^{-z^*}\ \vec{G}$$

The magnitude of the pressure gradient force was set as

Ae^{-z^*} where A is a constant.

The boundary conditions for the top of the inversion is that geostrophic balance exists, a balance between only pressure gradient force of the synoptic scale wind regime and the coriolis force.

These geostrophic balanced forces are

$$P_x = -fv_h$$

$$P_y = fu_h$$

$$A = \frac{-fv_{gs} - P_x}{e^{-z_s^*}}$$

Next, Schwerdtfeger and Mahrt defined the frictional forces.

$$F_x = k\frac{\P^2 u}{\P z^2}$$

$$F_y = k\frac{\P^2 v}{\P z^2}$$

Equations of balanced flow in non-dimensional form follow.

$$v^* + \frac{P_x}{A} + e^{-z^*} + \frac{\P^2 u^*}{\P z^{*2}} = 0$$

$$-u^* + \frac{P_y}{A} + \frac{\P^2 v^*}{\P z^{*2}} = 0$$

Non-dimensionalization with the following definitions:

$$u^* = \frac{uf}{A}$$

$$v^* = \frac{vf}{A}$$

$$q = \frac{\sqrt{2}}{2}$$

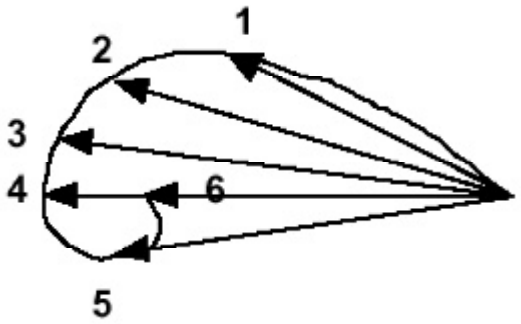
The Schwerdtfeger-Mahrt solutions follow.

$$u^*(z^*) = -\frac{1}{2}e^{-z^*} + \frac{P_y}{A} + \left(-a_1 e^{q\,z^*} + a_3 e^{-q\,z^*}\right)\sin q\,z^* + \left(a_2 e^{q\,z^*} - a_4 e^{-q\,z^*}\right)\cos q\,z^*$$

and

$$v^*(z^*) = -\frac{1}{2}e^{-z^*} + \frac{P_x}{A} + \left(-a_2 e^{q\,z^*} + a_4 e^{-q\,z^*}\right)\sin q\,z^* + \left(a_1 e^{q\,z^*} - a_3 e^{-q\,z^*}\right)\cos q\,z^*$$

These are parametric equations that are solutions to the differential equations written to describe vector added thermal winds to a typical and normal Ekman wind spiral. The normal Ekman wind spiral is shown immediately below. (Ekman spiral's were first describe in chapter nine.)



A few constants need defining.

$$a_1, a_2, a_3, a_4$$

are constants from integration and can easily be determined from boundary conditions.

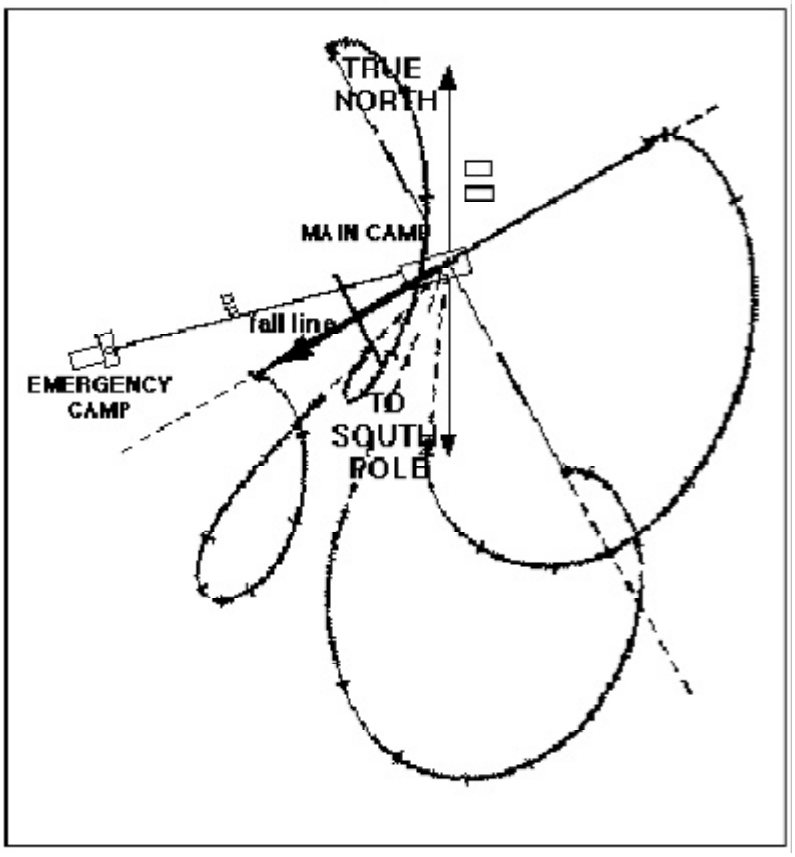
At the lower boundary

$$u = v = 0 \text{ at } z = 0.$$

At $z = h$

$$\frac{\partial^2 u}{\partial z^2} = \frac{\partial^2 v}{\partial z^2} = 0$$

i.e., the top of the friction layer coincides with the top of the inversion.

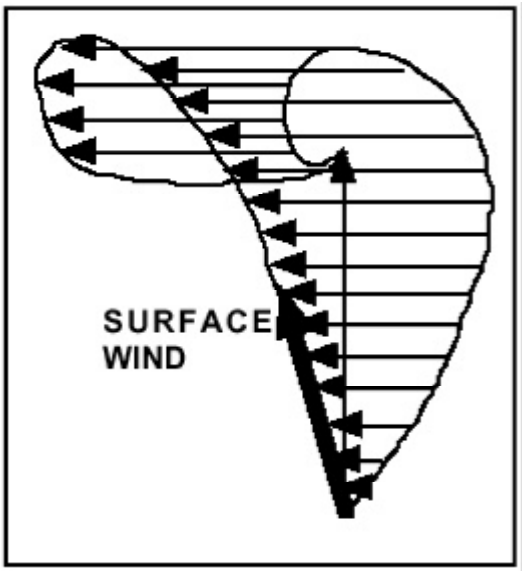


These modified Ekman spirals are the inversion winds superimposed over a sketch of Plateau Station showing the slope or fall line.

Professor Schwerdtfeger originally chose for the top of these spirals the four winds, North, East, South, and West. In this diagram I have oriented his spirals with the direction down the gentle plateau slope. As we follow each of the four spirals around, and down through the air to the snow surface, we see the amazing results both Schwerdtfeger and Lettau explained to Mort Rubin and Dalrymple back in the initial meeting five years earlier as Plateau Station was being planned. The wind speeds and directions on the snow surface were nearly the same and not down slope but at about forty-five degrees between the fall line and the perpendicular to the slope. The majority of the wind vectors, especially the strong snow carrying winds just above the snow surface but

below the top of the inversion, were dominantly sideways to the down slope no matter what the wind above the inversion was, even from any and all four wind points above the inversion.

For maximum impact for the sake of publishing these exciting results Prof. Schwerdtfeger and I chose a balloon series I launched at Plateau Station the days of 6-8 August in 1966. (Temperature and net radiation profiles for this series are shown in chapter nine.) If you placed your back to the wind at the surface on these days, the wind above the inversion was veering to the right. Said another way, it appeared that the wind was shifting clockwise relative to the observer on the ground. Such a shift of the wind was not a shift expected in the Southern Hemisphere. The exact opposite was expected. That indeed did get attention.



The thermal wind of necessity is a component of the wind that is always perpendicular to the temperature gradient. When the inversion causes a horizontal temperature gradient, it is fixed to the shape of the ice dome pointing from the cold surface temperature to some higher temperature down slope, aloft, but in the same horizontal plane as the point of origin. The thermal wind can be shown as an exponentially increasing vector altering the Ekman spiral as shown above. The resultant wind vector on the surface, with the observer's back toward the oncoming wind or the observer's face looking in the same direction as the wind vector, will turn the way it is supposed to in the Southern Hemisphere—toward the left. It will continue to turn leftward and get stronger and even turn counterclockwise at the higher levels of the inversion crossing over to the right. This crossover is easily missed with standard observational methods. My slow rising balloon series, in fact, captured this exact view.

It was a joy to publish these findings of my PhD research project with Prof. Werner Schwerdtfeger in the *Antarctic Journal of the United States* in 1970.

Giving reference to these findings and giving me priority as the discoverer of the inversion winds in nature, Werner Schwerdtfeger wrote in his more permanent book:

> "The result is a set of wind spirals— or hodographs— which show but little similarity with the original Ekman spiral for a barotropic boundary layer. Complete loops can appear, and it is interesting indeed that the occurrence of such loops in the hodographs of the real boundary layer has been confirmed by Sponholz at PLATEAU Station in 1966 as well as by Kobayashi (1978) at MIZUHO and Adachi (1979) at SYOWA." (Werner Schwerdtfeger, *Weather and Climate of the Antarctic*, page 55.)

The theoretical understanding of inversion winds, in the final analysis, over the past thirty years since the great meteorological studies from Plateau Station, has merged with katabatic winds in complex ways.

[Returning to the NSPT posted text:]

Wind in the frictional-layer over Plateau Station, August 7, 1966; temperature inversion between 1.5 and 400 m: 32°C.

Black circles: Vector averages of the wind measured by five soundings, between 0052 and 0842 GMT, during a stable weather situation ("steady state").

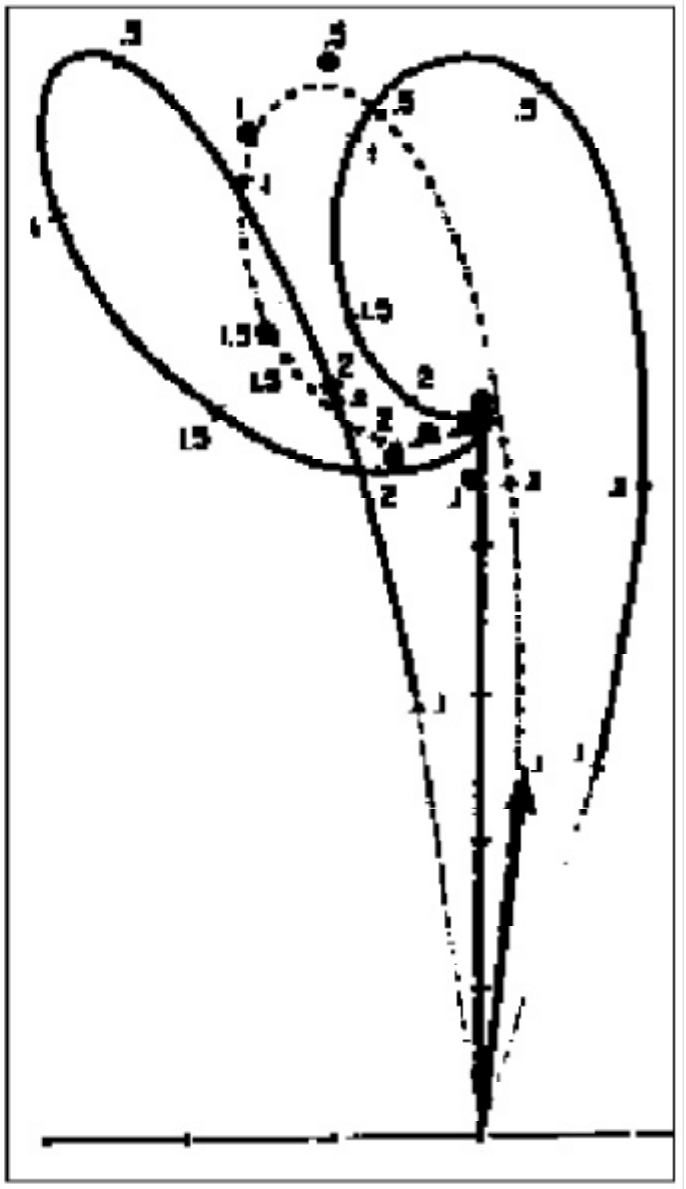
Heavy dashed arrow: Upper wind $\vec{V}_u$ (at 400 and 500m), from 55°, 5.4 m/sec. The three curves show individual theoretical wind spirals.

Dashed: Angle between thermal wind $\vec{V}_T$ (from 160°, along the contour lines of the terrain) and the upper wind $\vec{V}_u$ being $\alpha T = 105°$; $V_T = 3 V_u$; $K = 3 \cdot 10^3 \, cm^2 \, sec^{-1}$.

Solid at left: $\alpha T = 90°$; $V_T = 3 V_u$; $K = 3 \cdot 10^3 \, cm^2 \, sec^{-1}$.

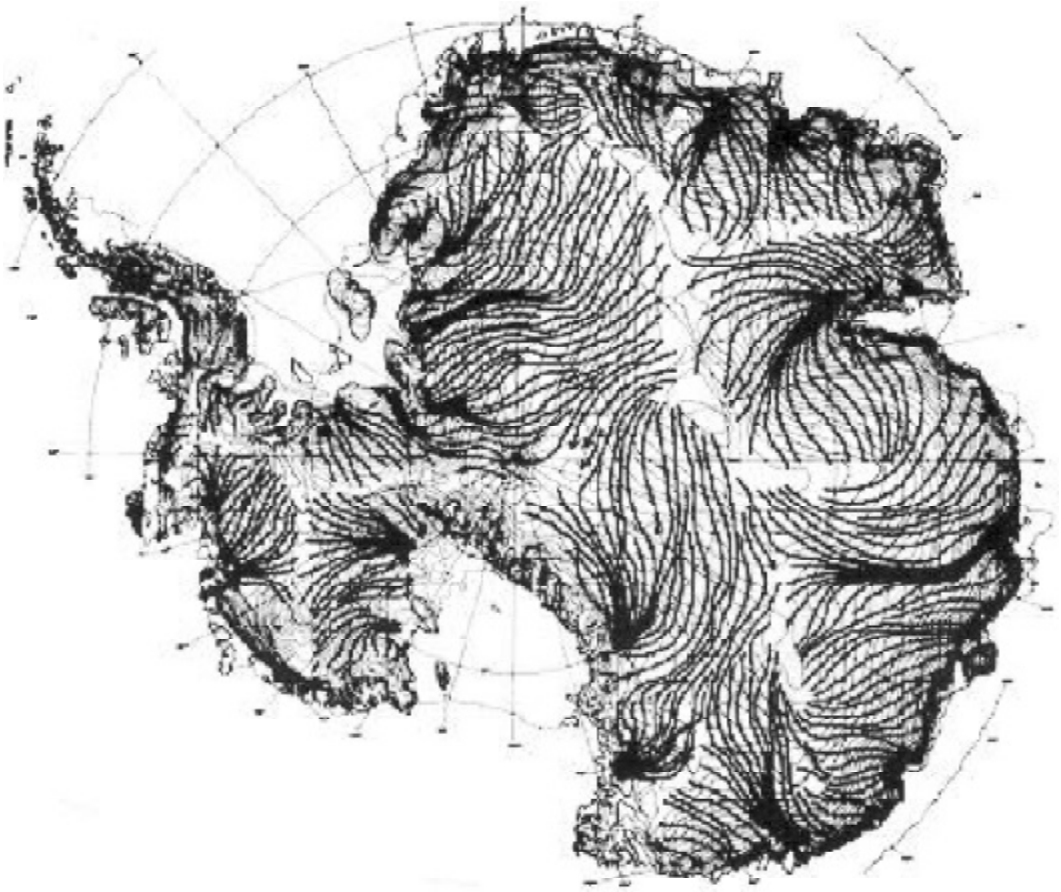
Solid at right: $\alpha T = 120°$; $V_T = 2.5 V_u$; $K = 2.5 \cdot 10^3 \, cm^2 \, sec^{-1}$.

Unit of height values of black circles and of marks along spirals: 100m.



I remain a disciple of Werner Schwerdtfeger and his inversion winds. They, and they alone are tied to the snow surface. These winds explain why cold domes of ice, such as Greenland and Antarctica, remain on a very warm planet. The warm moist air penetrates into the interior of the icecap where the great inversion causes the moisture to fall out while the inversion winds hold that moisture and snow on to the icecap. This circular bonding of the inversion shaping the winds that shape the icecap that again shape the inversion is a delicate environmental balance. Where that balance was broken, such as over North American by a collapse of the earth's crust now under Hudson's Bay that changed the snow surface, the ice dome dissipated and the ice age ended.

A letter of commendation for my outstanding work as a young weather forecaster, an Antarctic Service Medal from Congress for "courage, sacrifice, and devotion," and later, a plaque from the Department of Meteorology of the University of Wisconsin, signed by all members of my PhD com-



The surface wind field according to T. R. Parish and D. H. Bomwich, "Advances in antarctic geophysical sciences from the IGY to the present," *Antarctic Journal of the United State*s, National Science Foundation, Vol. XXI, No. 2, June 1986, page 9.

mittee and other friends, for my contributions to polar research, and the naming of Sponholz Peak in the Liberty Hills of the Ellsworth Mountains in Antarctica were rewards of the world. Nonetheless something was always very wrong.

I admired Tom Frostman on his return to the University of Wisconsin after his winter at Plateau Station. He honestly recognized his math skills were less than when he left for the seclusion of polar work. He quit graduate study to work with developing equipment and teaching units for the public school near his hometown in northern Wisconsin.

The mathematical modeling world, an automatic gift before Plateau, now for me was a struggle. This may have been the price for the experience in Antarctica. If so, I gladly pay it. The activities of discovery in the real world over against imaginary findings behind a desk or in a warm library permit no contest as to preference.

I join Richard E. Byrd:

"The one aspiration I still had was to be vindicated by the tiny heap of data

collected on the shelf in the Escape Tunnel. But, even as I seized upon this, I recognized its flimsiness; a romanticized rationalization, as are most of the things which men are anxious to be judged by. We men of action who serve science serve only a reflection in a mirror. The tasks are difficult, the objectives remote; but scholars sitting in bookish surroundings tell us where to go, what to look for, and even what we are apt to find. Likewise, they pass dispassionate judgment on whatever we bring back. We are nothing more than glamorous middlemen between theory and fact, materialists jobbing in the substance of universal truths."

"At the end only two things really matter to a man, regardless of who he is; and they are the affection and understanding of his family. Anything and everything else he creates are insubstantial; they are ships given over to the mercy of the winds and tides of prejudice. But the family is an everlasting anchorage, a quiet harbor where a man's ships can be left to swing to the moorings of pride and loyalty."

"A man doesn't begin to attain wisdom until he recognizes that he is no longer indispensable." (Richard E. Byrd, *Alone*, 1938)

Filled with self doubts and thoughts of decaying mental skills, I found my studies also were plagued with campus unrest. Protests against the war in Vietnam were boiling before I ever left for the Antarctic. Now Nixon ordered the invasion of Cambodia as well and the campus virtually blew up. Research and study performance as usual was more than difficult to maintain.

I remember in early spring, with demonstrations and protest marches increasing in ugliness and violence, Professor Hammer, my geophysics teacher and an invited professor on my PhD committee, announced that absence from a test on Monday when a campus wide student strike was called would result in an automatic failure in the course, absolutely no exceptions. Sheepishly, although I did have nearly shoulder length hair, I approached Prof. Hammer and begged an excuse for that Monday. Nancy was pregnant and our second baby was due on the very day. With moist eyes Dr. Hammer consented to my excuse because it was the only real life problem of a student he needed to deal with that was not connected to some political upheaval. Lisa Ann was born early that Monday morning and I did not have to miss class. Dr. Hammer sent Lisa her first pink dress as a gift a week later. That Monday we had class amidst tear gas.

I found no one in any of my science classes that believed as I was taught that the earth was created in six days and destroyed at the time of Noah in a global flood. Open ridicule waited for a person like me. What hurt more than open ridicule was the question about how I could get so far scientifically with the beliefs I had.

The University of Wisconsin made their doctoral program very clear as to what it was. The Graduate Catalog clearly stated that the PhD degree was a degree awarded not for classroom excellence alone but for a demonstrable philosophy. There simply was no creation philosophy of ice ages recognizable by any of the scientific communities. In the subject of polar science I knew them all. Some pastors and teachers of my church body wrongly claimed the best scientists still believed in Creation. I knew most of them. They did not! My own data looked right through and past Creation for millions of years.

In the end, despite great overall scientific success with my polar studies, evolution versus my personal faith in a literal interpretation of Scripture became a dominant inner conflict to the point of my inability to carry research forward. I could not remain loyal to both professors at the University and to

the teachings of my church. Things came to a head at a meeting with my PhD committee discussing the Russian language and Russian work as research tools. Lettau spoke and claimed that, "one who is dedicated to the study of the Polar region . . ." BOOM! I don't remember another word. As a layman out East who had served on two different constitutional committees establishing two different mission churches with the WELS I could not continue in the false teachings of evolution and accept any more of the world's laurels.

I loved the physics of the atmosphere. I believe if I had remained a pilot briefer or researcher with operational weather forecasting I would still be climbing the professional ladder of excellence and serving my country in this profession. As my meteorological career moved to the higher levels of theories and I needed to look to the global ice sheets for fundamental answers for energy exchanges with the atmosphere, the sea, and the ice sheets, questions turned to age and how the atmosphere evolved without a Heavenly Father. Explanations of nature by science had always sought answers that left the Creator out of the picture all the way back to Thales.

I no longer could with a Christian conscience remain in the PhD program. In tears I withdrew. Perhaps my own inability and lost skills, certainly the unrest related to the war in Vietnam, and the philosophy of evolution all played their roles in changing my profession.

Three people active in the WELS also had an influence. Dr. Sigbert Becker, a frequent speaker at our Lutheran Collegians' gatherings Sunday evenings was quick to encourage my career change saying, "We need to turn you into a teacher before you get used to those scientific salaries." The dedication and love for their work exuding from the grade school classrooms of Dan Schmeling, a high school classmate of mine, and Paul Boehlke, a very distant cousin, made suggestions like that of Dr. Becker's a possibility. I spoke to their school children and parent groups of their respective schools as a polar hero and visitor but there was never any doubt that the little children they taught knew Dan and Paul, their teachers, were their heroes.

A LAST LETTER

The University of Wisconsin
Department of Meteorology
Meteorology and Space Science Building
1225 West Dayton Street
Madison, Wisconsin 53706

February 14, 1971

Mr. Martin Sponholz
Luther High School
Onalaska, Wisconsin 54650

Dear Marty:

Thank you for your letter of February 5.

Indeed, since you told me you enjoyed your work at LHS very much, I was not too surprised by your decision. But I appreciate the frank way you write me about it. I shall not try to persuade you to change your mind, not only because you certainly have considered the pros and cons carefully before writing. I really think that good and dedicated high school teachers are at least as important as meteorological

researchers, and everyone of us should go, as long as he is young enough to choose, where he feels he can be efficient.

I have shown your letter to Lettau, Wahl, Kutzbach, Stearns, and Bentley, and all expressed more or less similar thoughts.

We also want to give you a little "document," nothing official, of course, but perhaps a friendly memento for you, and of interest for your children and grandchildren.

With best personal regards,
Werner Schwerdtfeger

END OF LETTER

Admiral Byrd's role for active men between theory and fact, though driven by others, is still the more exciting role, but it is found in teachers more than mountain climbers or polar explorers. In the service of my Lord's Church, what more can there be for me.

Still, there is a need for committed lay men and women to go to nature more than to the library. We must never stop learning lest we all fall into a dead orthodoxy that only sports words from books and not from the complete world our Lord has placed us in. An adult confirmand, a microbiologist who has done such advanced studies faced trouble when a pastor desired not to confirm her because she wouldn't accept his view of unalterable and immutable species because she could watch those species change under a microscope. When this happens, our church needs to train its pastors and teachers better in science.

This work I now do. At times I miss the accolades of my former profession. Then I think of what both the government (Pontius Pilate) and the church (Caiaphas) ordered done to Truth personified and I am humbled by the privilege to serve Him. "You may keep your gifts for yourself and give your rewards to someone else." (Daniel 5:17)

A POSTLUDE
by Paul R. Boehlke

A life is a canvas on which God paints. For some, God has used extremely broad and bold strokes. Events and journeys much larger than self occur, but the patterns can be hidden. Data is collected, but meaning is elusive. So it was in Marty's exceptional work as a researcher. The blinding white, the numbing cold, the screaming snow of the coldest place on Earth are all background for reflections and inner struggles.

Raised by his aunt, schooled in conservative German-Lutheranism, Marty came to work with the top theoretical meteorologists in the country: Lettau and Schwerdtfeger. Here among the wise, Marty learned how science was done by doing it. He worked at the cutting edge of his discipline. His greatest achievement was to successfully gather the measurements that supported the inversion winds theory. Nevertheless, at the same time Marty was impressed that without the theory, he would not have been compelled to make the balloons rise slower.

Books that show how science works, written by someone who was there, are rare. Those who have read The Double Helix by James Watson will see some of the same themes: theory selects the data, expectations define the observations, personalities clash. Science is very human. There are frustrations, politics, turf protection, stolen data, and doubts. To the complexities of large scale, government-funded research, Marty adds insight into working with military support and various government agencies. But he also reflects the lure, love and excitement of exploration and discovery. Above all, Marty's book is unique because he has read, loves, and shares the history of his subject.

Furthermore, Marty is unique because he risked his life and health to get his data. The single sentence/paragraph: "It was incredibly cold," chills the reader to the bone and speaks volumes. And at the same time the coldness and the loneliness put Marty's faith on the line. He had the only Bible at Plateau Station , and that is how he continued to feel while studying at the feet of outstanding scientists. He found himself questioning his beliefs: separating traditions and human opinions from Scripture. At the same time he saw scientific data bend and its truth change. He saw that some explanations were favored; others were laughed at. In the end God calls him to work in his church.

Marty and I have known each other for many years. We attended Wisconsin Lutheran High School at the same time, and later Aunt Edna would always report to me on my cousin. We have also enjoyed sharing an office for many years at Martin Luther College. I have often listened to Marty's fascinating experiences, and I urged him to record especially the Antarctic years, for the insights that come from writing, and so that his family, students and friends might also see his journey. His story is not a showy, superficial snowmobile trip across Antarctica, but it is a mission filled with hard science.

There are indictments of some of the aberrations in Christian education. We can learn from Marty's candid reflections and benefit from them. We do students no good if we support Scripture with human reason or if we think that science produces certain truth. We do no good if we favor athletic students over others. And we do no good if graduates of our schools know only their weaknesses, without realizing that God is making them into new people: able with His help to achieve excellence in this world.

Certainly, Marty's journey among the magi was formative. Martin Luther reminded us a long time ago that Christians are not finished products, but rather we are in the process of becoming that which we will be. God works in our lives for His purposes so that we grow and are more and more able to do His work. The journey among the magi certainly prepared Marty well for the call he now holds at Martin Luther College: teaching our future churchworkers. At MLC Marty continues to function as an extremely valuable member of our small science department. He is, of course, able to speak with authority on the content of science; but more importantly, he is also able to teach about the nature of science and its truth claims. It is a privilege to be associated with him and to have been asked to read this manuscript.

Paul R. Boehlke

Epiphany, 1995.

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"The wind in its everlasting flight sweeps over these tracks in the desert snow. Soon all will be blotted out.
But the rails of science are laid; our knowledge is richer than before.
And the light of the achievement shines for all time."

(Written as an introduction by Fridtjof Nansen to Roald Amundsen's The South Pole, MAY 3, 1912)